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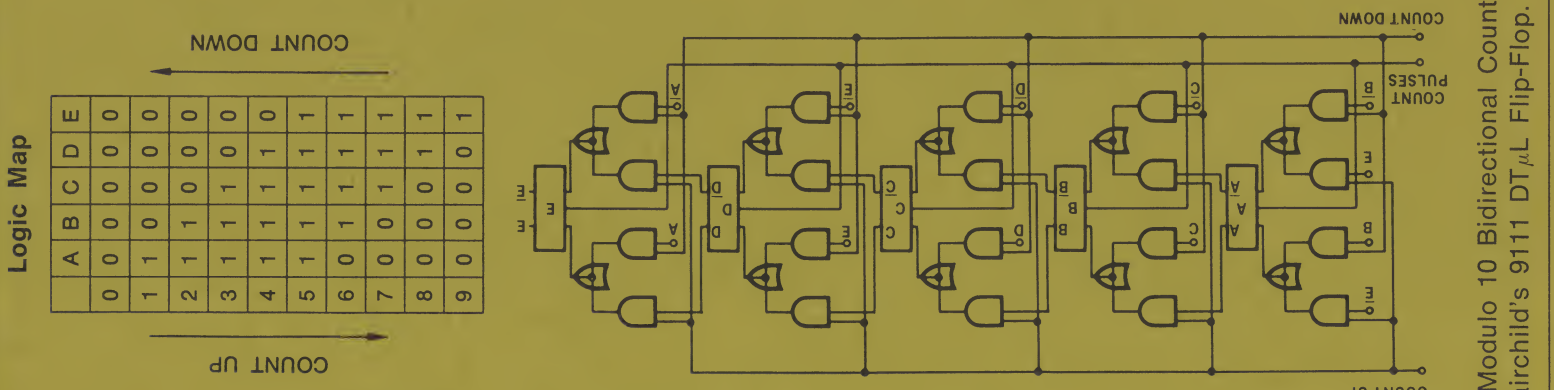
A TECHNICAL INFORMATION AND APPLICATION BULLETIN

JANUARY 1967

FAIRCHILD
SEMICONDUCTOR



	A	B	C	D	E
0	0	0	0	0	0
1	1	0	0	0	0
2	1	1	0	0	0
3	1	1	1	0	0
4	1	1	1	1	0
5	1	1	1	1	1
6	0	1	1	1	1
7	0	0	1	1	1
8	0	0	0	1	1
9	0	0	0	0	1

Figure 2—Modulo 10 Bidirectional Counter utilizing Fairchild's 9111 DTμL Flip-Flop.

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NEW:— COST/SPACE-SAVING DTμL CLOCKED FLIP-FLOP

Fairchild's new DTμL clocked flip-flop, the 9111, has a pair of two-input gates to implement AND/OR functions at logic inputs, permitting a reduction in the number of elements needed in many logic designs. It utilizes the master-slave principle of operation; and is designed specifically for use where two separate data sources must be combined into a central storage system (illustrated in Figure 1).

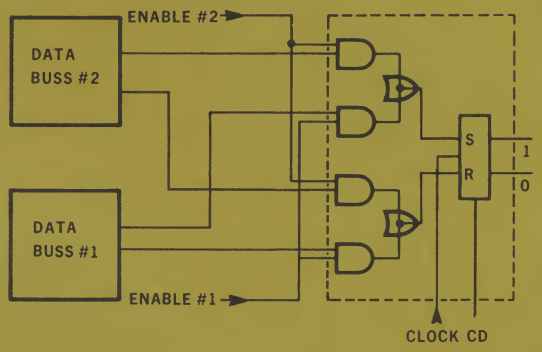

Figure 1—Two separate data sources combined into a central storage unit utilizing Fairchild's 9111 DTμL Flip-Flop.

The flexibility of this new flip-flop and its ability to simplify circuit requirements and lower costs is demonstrated by the modulo 10 bidirectional counter shown in Figure 2. The 9111 is the only element in the Diode Transistor Logic family of digital integrated circuits capable of performing the function shown in Figure 2 with only five elements, without external gating.

In this bidirectional counter, the 9111 replaces either five 9931's, five 9945's, or five 9948 flip-flops; plus twenty DTμL two-input gates.

This latest addition to Fairchild's wide line of compatible digital integrated circuits is on your Fairchild distributor's shelf. Contact him for specific pricing information. For a data sheet write Fairchild Semiconductor, P.O. Box 1085, Mountain View, California 94040.

NEW TEMPERATURE-STABLE PREAMPLIFIER μA726 MONOLITHIC INTEGRATED CIRCUIT PROVIDES 0.2 μV/°C and 30 PA/°C TEMPERATURE TRACKING

The μA726 is a monolithic integrated circuit that provides the engineering circuit designer with a preamplifier which will withstand environmental stresses and still continue to maintain guaranteed specific operating characteristics. This technologically advanced device, fabricated on a 45-mil-square die, consists of an extremely well-matched differential transistor pair combined with a temperature-control amplifier. The temperature is controlled by power dissipation within the chip.

Two transistor base-emitter junctions provide the temperature sensing function. The emitter-base voltages of these devices are summed and applied across a resistor to produce a current which is inversely proportional to chip temperature. This current is then amplified by the gain of two transistors, one of which is a high-power device. The high-power transistor is operated at a collector-emitter voltage of 30 volts, with an initial maximum available current of 50 milliamperes. This provides a 1.5 watt power capability to heat the chip rapidly. Because the chip is small, it reaches a stabilization temperature in less than 1 second. As the chip is heated, the output stage current is reduced until the chip temperature is stabilized. For most applications, the quiescent power to maintain the desired die temperature is less than 250 milliwatts. The μA726 will operate over the ambient temperature range of −55°C to +125°C. An external resistor is used to select the desired operating chip temperature.

The circuit design and layout of the chip are unique in that the temperature-sensing elements are centrally located, with the power dissipation device on one side and the differential pair on the other. This scheme has proven to give optimum temperature control. Fairchild's Planar* II processing assures inherent quality and reliability.

Offering an impressive list of electrical characteristics; the offset voltage temperature coefficient of the μA726 is typically 0.5 microvolt per °C. Offset current temperature coefficients have been recorded as low as 10 picoamperes per °C.

The μA726 is ideal for use in instrumentation and operational amplifiers, or in any application where low-level signal processing is necessary.

The μA726 also provides superior performance over discrete and dielectrically isolated transistor differential pairs.

Typical performance characteristics for the μA726, monolithic temperature stabilized transistor pair, are given below:

h_{FE} (with T = −55°C to 125°C)
@ I_C = 100 μA, V_{CE} = 5 V 200
@ I_C = 10 μA, V_{CE} = 5 V 100

V_{BE1} - V_{BE2}
@ V_{CE} = 5 V, I = 10 μA - 100 μA . . . 1 mV

BV_{CES} . . . . . 25 V

LV_{CEO} . . . . . 30 V

Input Offset Voltage
Long Term Drift
@ I_C = 10 μA, V_{CE} = 5 V 5μV/wk

h_{FE} (small signal, short circuit)
@ V_{CE} = 5V, I_C = 100 μA,
f = 20 mHz 3.5

Noise Voltage
@ .001 Hz - 0.1 Hz . . . . . 4μV - P-P
@ 0.1 Hz - 10 kHz . . . . . 10μV - P-P

Input Offset Voltage
Temperature Coefficient
(−55°C to +25°C and +25°C to +125°C)
@ I_C = 10 μA - 100 μA . . . . . 0.2μV/°C

Input Offset Current
Temperature Coefficient
(−55°C to +25°C and +25°C to +125°C)
@ I_C = 10 μA - 100 μA . . . . . 0.03 nA/°C

An immediate application for this new integrated circuit is as a preamplifier in combination with the μA709, Fairchild's high-gain monolithic operational amplifier. This combination will compete with chopper amplifiers, which generally require twice the power and space, offer lower frequency response, and operate over a limited temperature range (approximately +10°C to +60°C).

The typical specifications obtainable with the μA726 and μA709 are listed below:

Open Loop Gain	120 dB
Temperature Coefficient of Input Offset Voltage	1 μV/°C
Temperature Coefficient of Input Offset Current	30 pA/°C
Bandwidth (0 dB frequency)	200 kHz
Long-Term Drift	5 μV/wk
Operating Temperature Range	−55 to +125°C

Another interesting application for the μA726 is as an extremely stable precision reference diode. For this application, the two transistors would be connected in a common emitter configuration with the base of either transistor and the collector of the other as cathode and anode terminals. Measured drift performance for this configuration has been less than 1 ppm/°C (.0001 %/°C). The nominal avalanche voltage range is 6.8V to 7.4V.

For the ultimate in a −55°C to +125°C temperature-stable preamplifier/transistor pair/voltage reference, order the μA726 by part number U5J772631X; or U5J772632X for 0 - 85°C industrial operating temperature ranges.

Your local Fairchild distributor has these devices in stock and can supply detailed pricing information. For specific technical data contact your local Fairchild Sales Office, or write Fairchild Semiconductor, P.O. Box 1085, Mountain View, California 94040.

150-VOLT, LOW-NOISE EPOXY PNP TRANSISTORS

Highest voltage available in a TO-5 epoxy packaged transistor (150 volts minimum); high beta and excellent linearity over a wide current range; low NF over a wide range of impedances from 100 Hz to 1.0 MHz; plus the proven reliability of Planar* II are all features of Fairchild's new 2N4888 and 2N4889.

These latest additions to Fairchild's wide line of silicon transistors will find excellent usage in high-voltage switches, as well as audio, video, IF, RF, and linear amplifiers in industrial, consumer, and computer equipment.

Some of the outstanding characteristics of the 2N4888 and 2N4889 are shown below:

Feature Characteristics

	2N4888	2N4889
LV_{CEO}(minimum) at I_C=2mA	150 V	150 V
Beta (minimum) at I_C=1mA	30	70
at I_C=10mA	40-400	80-300
NF (maximum) at f = 100Hz	—	10 dB
at f = 1kHz	—	3 dB
at f = 1MHz	—	4 dB

As a sample of the price range, the 2N4888 is priced from $1.20 in small quantities down to 48¢ in lots of 10,000. The 2N4889 is $1.80 and 72¢ in equivalent quantities.

For specifics, write for Fairchild data sheets at P.O. Box 1085, Mountain View, California 94040. For detailed pricing information, contact your Fairchild Distributor who has these devices in stock.

*Planar is a patented Fairchild process.